



Volume III

Hydrologic Analysis and Flow Control/BMPs





Volume III

- Chapter 1 – Introduction
- Chapter 2 - Hydrologic Analysis
- Chapter 3 - Flow Control Design
- Appendix III-A: Isopluvial Maps for Design Storms
- Appendix III-B: Western Washington Hydrology Model





Chapter 2
Hydrologic Analysis

- **<u>Single-Event Model:</u>**
  - Volume-Based Treatment BMPs
    - Curve Number Changes
- **<u>Continuous Simulation Model:</u>**
  - Flow Control BMPs
  - Flow Rate-Based Treatment BMPs (and Volume-Based in Future)





Volume III
Chapter 3 - Flow Control Design

- **Roof Downspout Controls:**

On-site BMPs necessary for Manual Equivalency:

  - Infiltration Systems
  - Dispersion Systems
  - Perforated Stub-Out Connections





Volume III
Chapter 3 - Flow Control Design

- **Detention Facilities:**
  - Ponds, Tanks, Vaults, Others
  - Control Structures
- **Infiltration Facilities:**
  - Flow Control (NOT for Treatment)





Flow Control
Minimum Requirement # 7

- **<u>Purpose:</u>**
  - To prevent increases in stream channel instability or erosion rates
- **<u>Requires Adopting Flow Duration Standard:</u>**
  - To control the extent of time that high flows discharge to streams





Minimum Requirement # 7
Flow Duration Standard

- Requires matching pre-development discharge duration from ½ of 2-year to 50-year peak flows
- Needs a calibrated Continuous Simulation Model to demonstrate compliance





Western Washington Hydrology Model **(WWHM)**

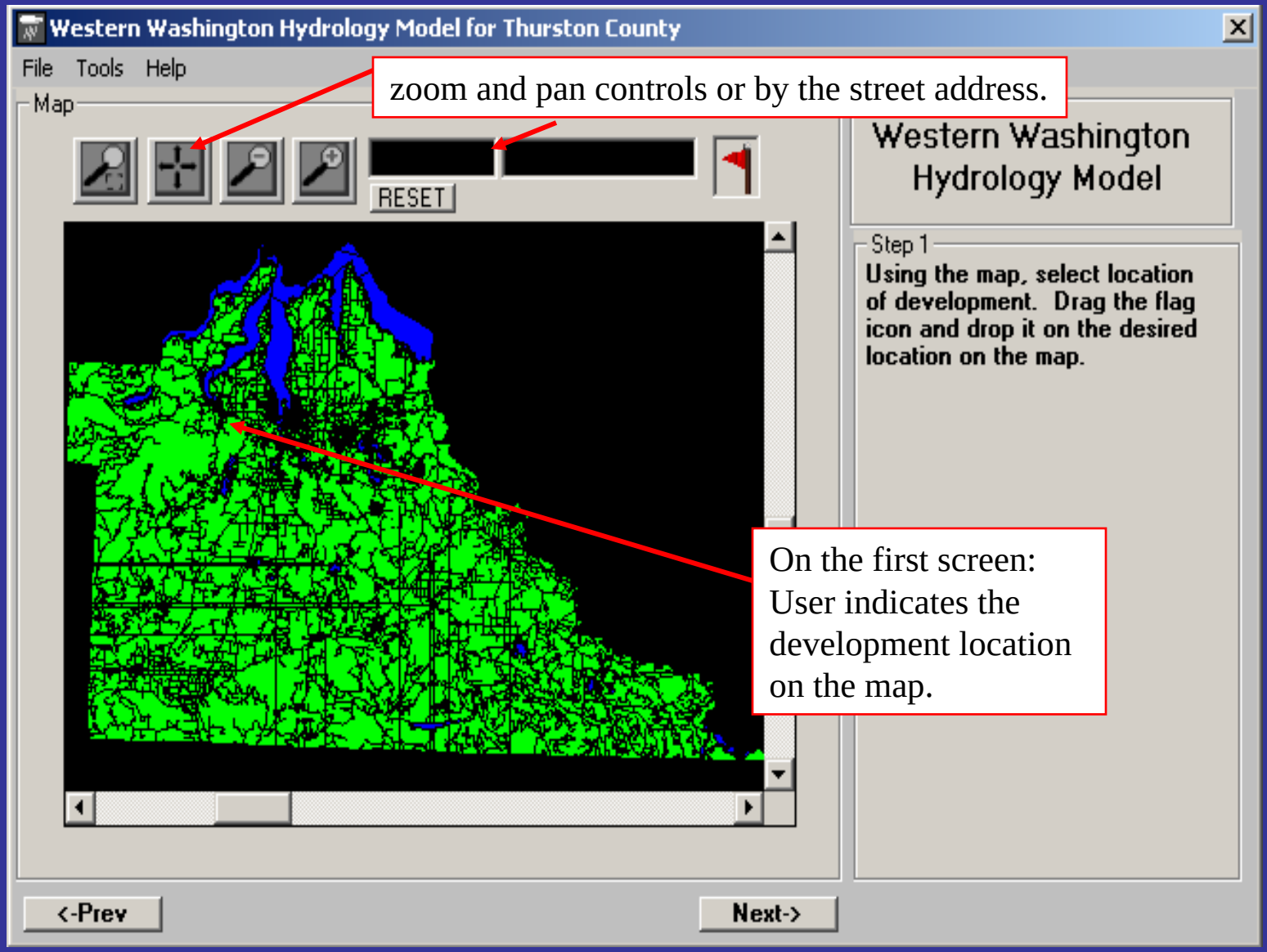
- Based on EPA's Hydrological Simulation Program - Fortran (HSPF)
- Includes Graphic and Menu Screens to facilitate:
  - Data entry; Program Execution; Output Analysis; and Design Reviews

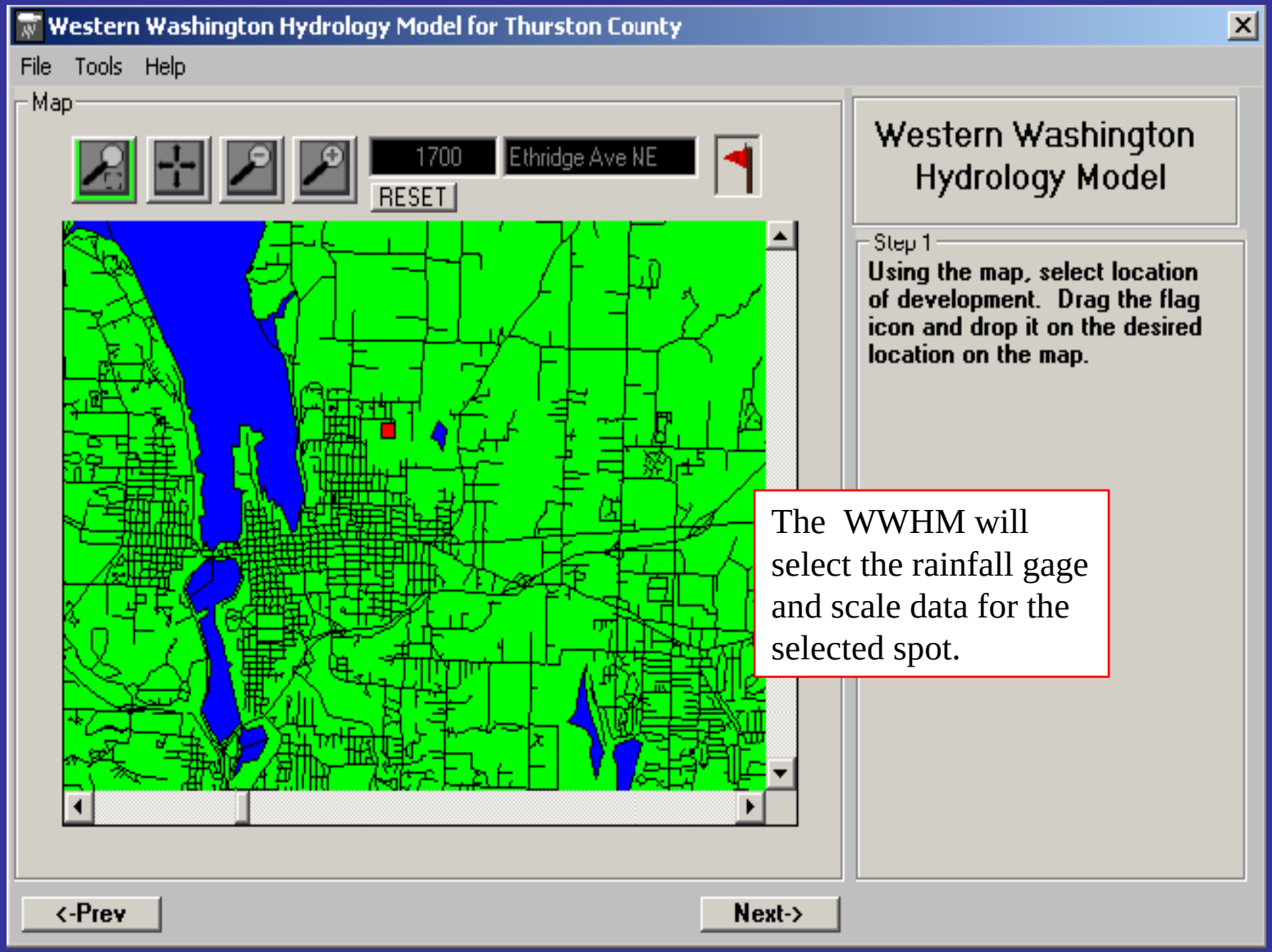


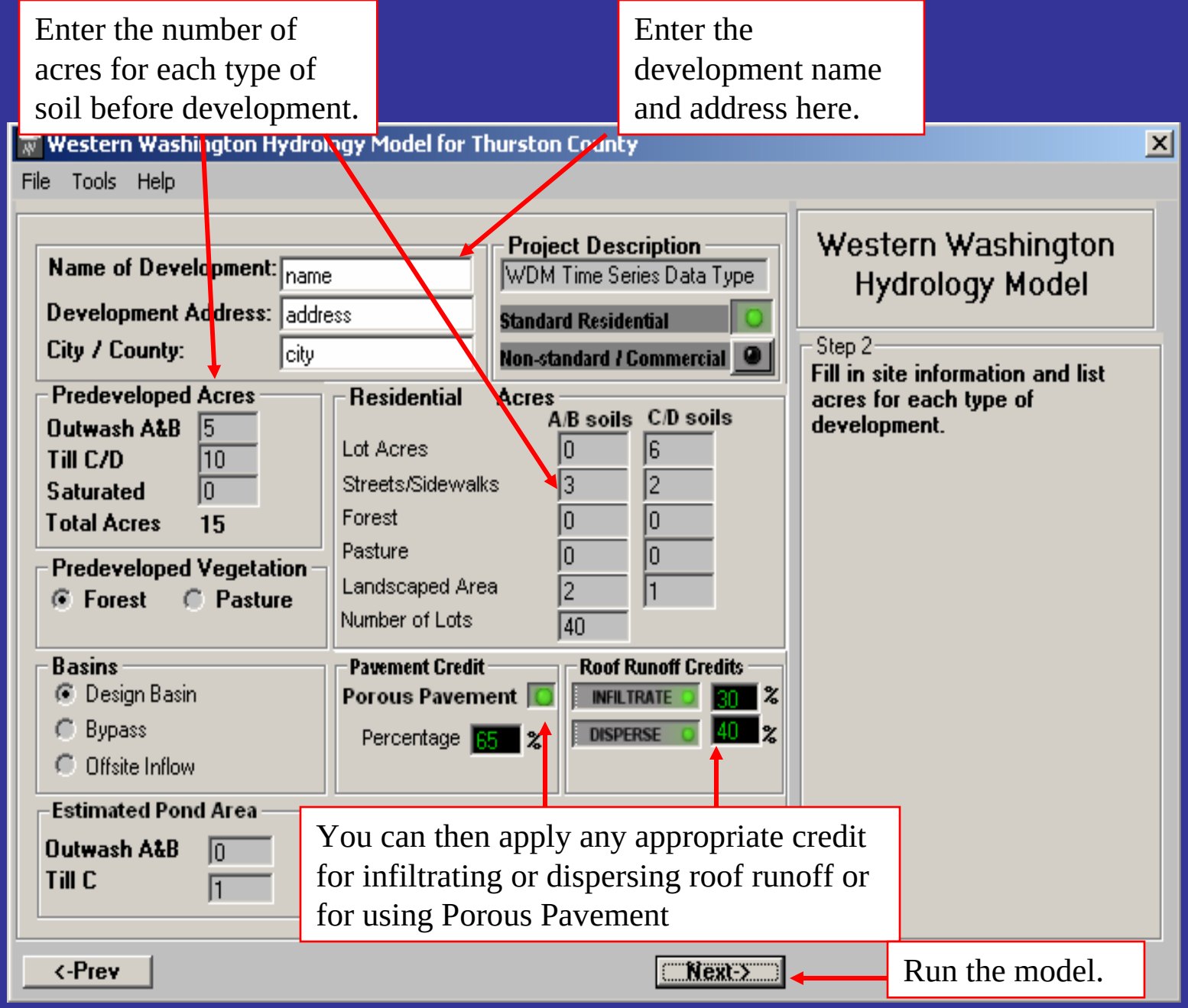


Western Washington Hydrology Model **(WWHM)**

- Uses Default calibrated parameters
- Locally calibrated parameters and/or rainfall data may be used with Ecology concurrence
- Alternative models may be used with Ecology concurrence (e.g., King County Runoff Time Series)


Western Washington Hydrology Model for Thurston County
File
Tools
Help
Map
RESET
Western Washington Hydrology Model
Step 1
Using the map, select location of development. Drag the flag icon and drop it on the desired location on the map.
<-Prev
Next->
zoom and pan controls or by the street address.
On the first screen: User indicates the development location on the map.


Western Washington Hydrology Model for Thurston County
File
Tools
Help
Map
1700
Ethridge Ave NE
RESET
Western Washington Hydrology Model
Step 1
Using the map, select location of development. Drag the flag icon and drop it on the desired location on the map.
The WWHM will select the rainfall gage and scale data for the selected spot.
<-Prev
Next->


Enter the number of acres for each type of soil before development.
Enter the development name and address here.
Western Washington Hydrology Model for Thurston County
File
Tools
Help
Name of Development:
name
Development Address:
address
City / County:
city
Project Description
WDM Time Series Data Type
Standard Residential
Non-standard / Commercial
Western Washington Hydrology Model
Step 2
Fill in site information and list acres for each type of development.
Predeveloped Acres
Outwash A&B 5
Till C/D 10
Saturated 0
Total Acres 15
Residential Acres
A/B soils
C/D soils
Lot Acres 0 6
Streets/Sidewalks 3 2
Forest 0 0
Pasture 0 0
Landscaped Area 2 1
Number of Lots 40
Predeveloped Vegetation
Forest
Pasture
Basins
Design Basin
Bypass
Offsite Inflow
Pavement Credit
Porous Pavement
Percentage 65 %
Roof Runoff Credits
INFILTRATE 30 %
DISPERSE 40 %
Estimated Pond Area
Outwash A&B 0
Till C 1
You can then apply any appropriate credit for infiltrating or dispersing roof runoff or for using Porous Pavement
<-Prev
Next->
Run the model.

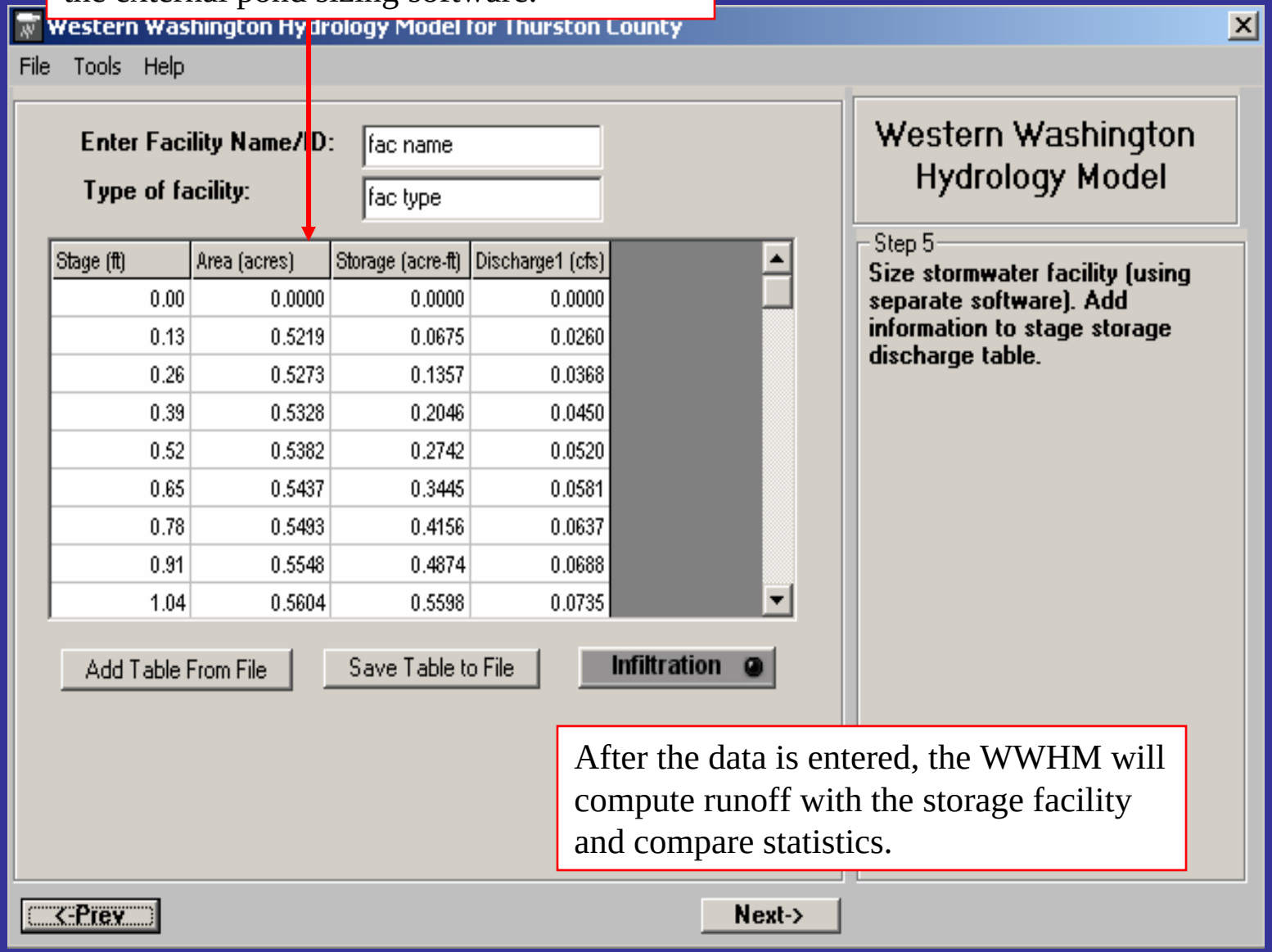




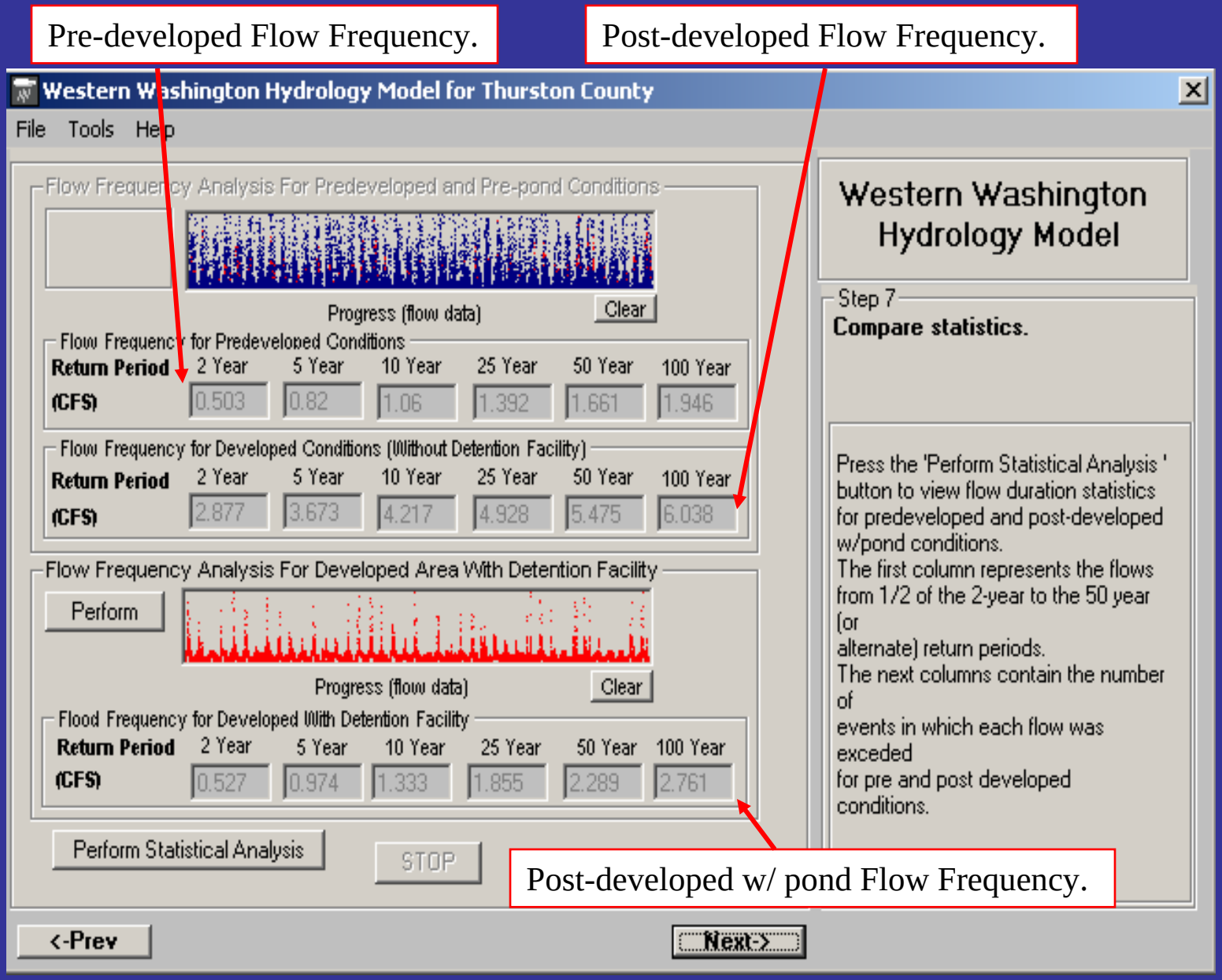
Western Washington Hydrology Model **(WWHM)**

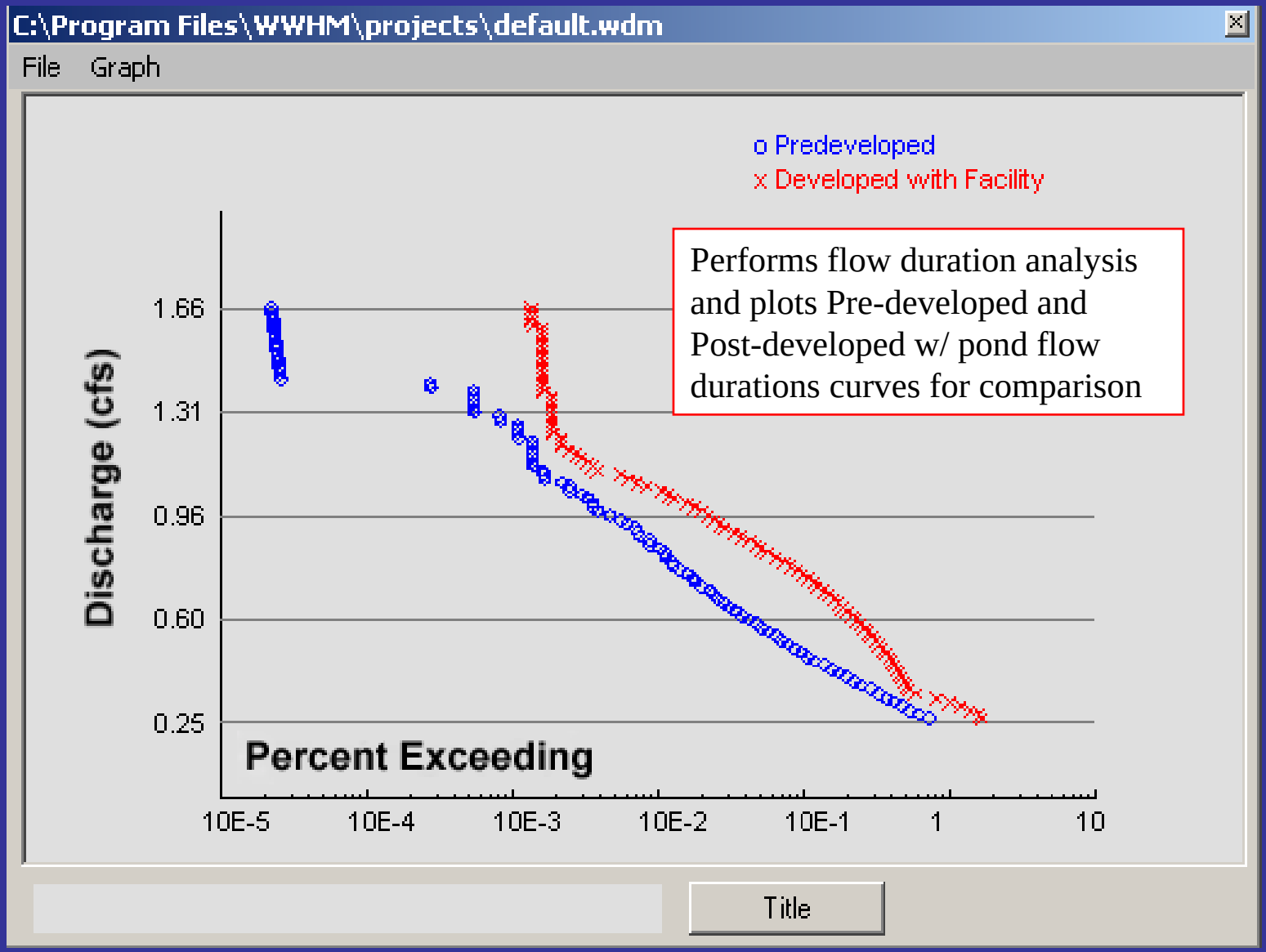
- **Doesn't provide Facility Sizing Algorithm**
- **Use a Commercial Software Package or a Spreadsheet (an example provided) to Size Facilities**
- **Input Facility Characteristics into the Model:**
  - **Stage-Storage-Discharge Table**

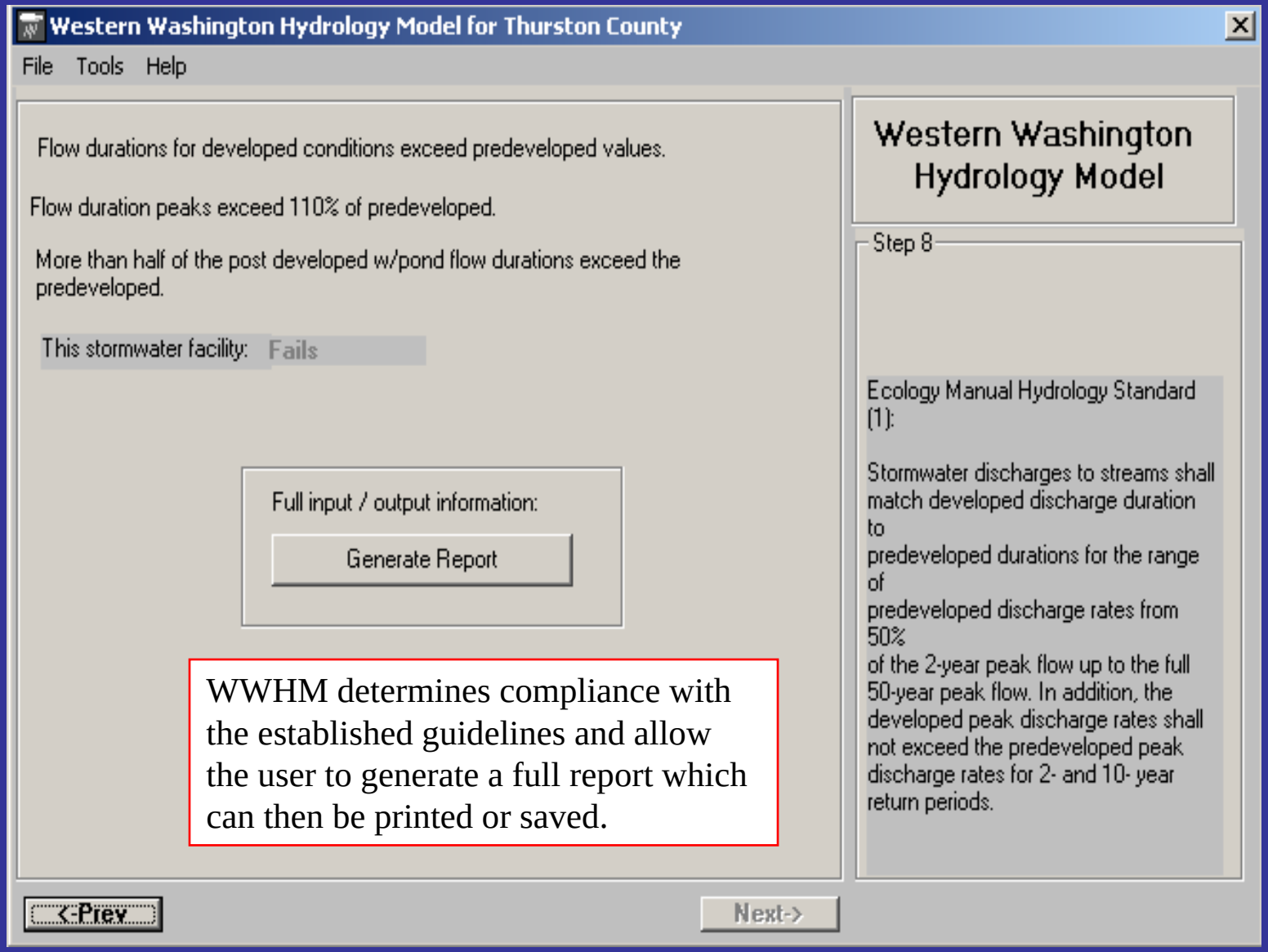
This screen allows the user to enter data which describes the storage facility based on the external pond sizing software.



After the data is entered, the WWHM will compute runoff with the storage facility and compare statistics.


Pre-developed Flow Frequency.
Post-developed Flow Frequency.
Western Washington Hydrology Model for Thurston County
File Tools Help
Flow Frequency Analysis For Predeveloped and Pre-pond Conditions
Progress (flow data)
Clear
Flow Frequency for Predeveloped Conditions
Return Period 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year
(CFS) 0.503 0.82 1.06 1.392 1.661 1.946
Flow Frequency for Developed Conditions (Without Detention Facility)
Return Period 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year
(CFS) 2.877 3.673 4.217 4.928 5.475 6.038
Flow Frequency Analysis For Developed Area With Detention Facility
Perform
Progress (flow data)
Clear
Flood Frequency for Developed With Detention Facility
Return Period 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year
(CFS) 0.527 0.974 1.333 1.855 2.289 2.761
Perform Statistical Analysis
STOP
Post-developed w/ pond Flow Frequency.
<-Prev
Next->
Western Washington Hydrology Model
Step 7
Compare statistics.
Press the 'Perform Statistical Analysis ' button to view flow duration statistics for predeveloped and post-developed w/pond conditions.
The first column represents the flows from 1/2 of the 2-year to the 50 year (or
alternate) return periods.
The next columns contain the number of
events in which each flow was exceded
for pre and post developed conditions.


C:\Program Files\WWHM\projects\default.wdm
File
Graph
o Predeveloped
x Developed with Facility
Performs flow duration analysis and plots Pre-developed and Post-developed w/ pond flow durations curves for comparison
Discharge (cfs)
1.66
1.31
0.96
0.60
0.25
Percent Exceeding
10E-5
10E-4
10E-3
10E-2
10E-1
1
10
Title



WWHM determines compliance with the established guidelines and allow the user to generate a full report which can then be printed or saved.





WWHM Summary Report

- Site Information Summary:
  - Name; Address; Soils; Development Type; Acres
- Detention Pond Design:
  - Stage/Storage Discharge Table
- Compares Runoff Statistics:
  - Pre- Developed & Post-Developed
- Determines Compliance





WWHM Menu Items

- **File Menu:**
  - Save or Load project Information
- **Tools Menu:**
  - Access Advanced Features - e.g., Edit the Model Input Parameters
- **Help Menu:**
  - Written and On-line Documentation

Web Address:
http://www.ecy.wa.gov/programs/wq/stormwater/wwhm_training/instructions.html

General Questions